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(54) Title: METHOD AND APPARATUS FOR DISPLAYING INFORMATION IN A FAULT MANAGEMENT SYSTEM

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(57) Abstract

A system and method for monitoring alarm information in a fault management system of a network and for minimizing the amount of alarm information displayed in a graphical display system. An alarm message indicating an alarm condition for a specific element in the network is received (100) by the graphical display system. Information about the specific element is extracted (102) from the alarm message, and a graphical object for the specific element is created (106) based on the extracted information. The graphical object is then displayed on a network operator interface. Once the alarm condition is cleared (110), the graphical object is removed (120) from the graphical display system.

(57) Abrégé

L'invention concerne un système et un procédé de surveillance d'informations d'alarme dans un système de gestion des incidents d'un réseau et de réduction de la quantité d'informations d'alarme affichées dans un système d'affichage graphique. Un message d'alarme indiquant un état d'alarme pour un élément spécifique dans le réseau est reçu (100) par le système d'affichage graphique. Des informations sur l'élément spécifique sont extraites (102) du message d'alarme, et un objet graphique est créé (106) pour l'élément spécifique sur la base des informations extraites. L'objet graphique est ensuite affiché sur une interface exploitant de réseau. Une fois l'état d'alarme effacé (110), l'objet graphique est retiré (120) du système d'affichage graphique.

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(71) Applicant: TELEFONAKTIEBOLAGET L M ERICSSON (publ) [SE/SE]; S-126 25 Stockholm (SE).

(72) Inventors: TSE, Edwin; 4976 Jean Brillant, Montreal, Quebec H3W 1T7 (CA). GOSSELIN, Nicolas; 110 du Blainvillier, Blainville, Quebec J7C 4Y1 (CA).

(74) Agent: ERICSSON RADIO SYSTEMS AB; Common Patent Department, S-164 80 Stockholm (SE).

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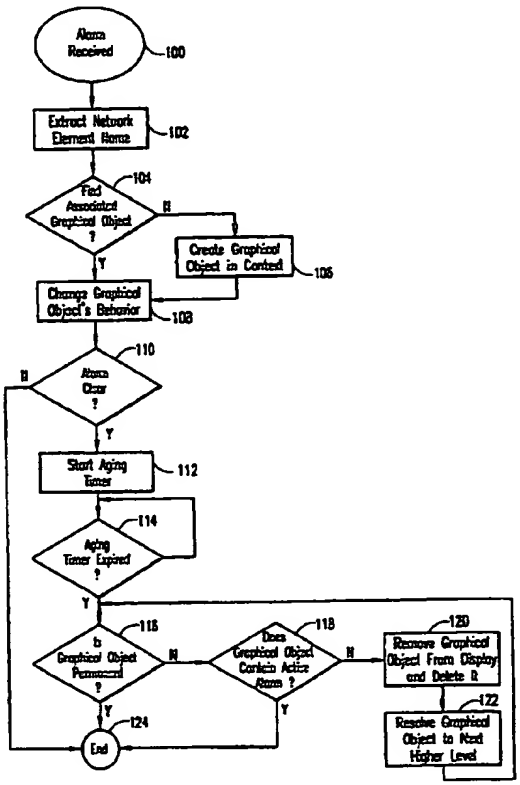

(57) Abstract: A system and method for monitoring alarm information in a fault management system of a network and for minimizing the amount of alarm information displayed in a graphical display system. An alarm message indicating an alarm condition for a specific element in the network is received (100) by the graphical display system. Information about the specific element is extracted (102) from the alarm message, and a graphical object for the specific element is created (106) based on the extracted information. The graphical object is then displayed on a network operator interface. Once the alarm condition is cleared (110), the graphical object is removed (120) from the graphical display system.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Description

METHOD AND APPARATUS FOR DISPLAYING INFORMATION IN A FAULT MANAGEMENT SYSTEM

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates in general to the management of network resources, and in particular to a method and system for displaying network management information in a data or telecommunication network.

Description of Related Art

A fault management system is an alarm surveillance system for handling errors or faults in telecommunication and data communication networks. Such networks typically include a number of network elements, such as computer switches, routes, ports, or T1 circuits. In a fault management system, network elements are represented as managed objects, which are software objects that correspond to the actual network elements under alarm surveillance. When the fault management system receives an alarm for a particular network element, the fault management system stores the alarm state for that network element in the corresponding managed object. Accordingly, the fault management system monitors the existence and state of faults throughout the managed network.

The fault management system further includes a graphical display system for displaying network alarms on an operator monitor. The graphical display system manipulates graphical objects or icons that depict network elements in the network. A management information base associated with the graphical display system stores information about each graphical object, including the position of the network element

that corresponds to the graphical object in relation to other network elements and the name of the network element represented by the graphical object. When the fault management system receives an alarm bearing the name of an "alarmed" network element, the graphical display system searches for the graphical object that represents the alarmed network element. If the search is successful, the graphical display system alters the behavior of the graphical object to indicate the alarm state (e.g., by causing the appropriate icon to blink in red to indicate a critical alarm). On the other hand, if the search fails, the graphical display system will alter the behavior of a specialized graphical object created to indicate alarms bearing network resource names that are unknown to the graphical display system.

By displaying the network elements and indicating alarms on the display, the graphical display system informs a human operator for the fault management system of the current faults in the system. Typically, the graphical objects are superimposed on a geographical background map so that the human operator has a sense of the locations of the alarmed network elements. In addition, interconnections of the various graphical objects can be shown so that the operator can visualize the relationships among the alarmed network elements. Based on the displayed relationships among network elements and the operator's work experience, the operator can identify correlations among multiple alarms to assist in handling the system faults.

As data and telecommunication networks become increasingly larger, however, this type of graphical display system becomes more and more problematic. To maintain data on every element of the network, the management information base must be extremely large. As a result, it is virtually impossible to keep the management

information base and the graphical display system up to date with the current layout and structure of a continuously evolving network. In addition, if the network operator manages the network via an Internet server, the download time for the graphical display system can be prohibitively long for a large network.

As an alternative to including a graphical object that corresponds to each and every network element, the graphical display system can be set up such that a number of network elements are represented in the graphical display system by a single graphical object. This approach, however, places increased demands on processing resources since the graphical display system must consider the alarm states of a number of network elements to determine the behavior of a single graphical object. If the number of network elements represented by a single graphical object is relatively large, then it is likely that the graphical object will consistently be in an alarmed state since it is likely that at least one of its many corresponding network elements will be in an alarm state at any given time. This result reduces the effectiveness of the graphical display system.

There is a need, therefore, for a system and method for displaying information in a graphical display system of a fault management system in an effective and efficient manner. Preferably, such a system and method would not require large amounts of memory to store data relating to each of the numerous network elements and would not require time-consuming updates to the graphical display system so that it fully corresponds to the actual network. Such a graphical display system would reduce the amount of data needed to operate the fault management system so that it could be implemented in an Internet browser environment and would not place an undue burden on the processing resources of the fault management system. Finally,

the system would preferably include one graphical object for each network element, to assist the operator to more rapidly identify the cause of and handle faults in the network.

SUMMARY OF THE INVENTION

The present invention comprises a system and method for monitoring alarm information using a graphical display system in a data or telecommunication network. Such a network generally includes a plurality of network elements. When one of the network elements detects a fault, the network element generates an alarm message that is forwarded to the graphical display system. The graphical display system extracts alarm information from the alarm message and creates a graphical object corresponding to the alarmed network element. In addition, the graphical display system creates additional graphical objects necessary to display the alarmed network element in proper context. Generally, this includes graphical objects representing each of the network elements that form a supervising chain of network elements for the alarmed network element. The behavior of the alarmed graphical object is selected so as to indicate the alarm condition, such as by causing the alarmed graphical object to flash in red to indicate a critical alarm condition.

The display of the alarmed graphical object in its appropriate context allows a network operator to take action to correct or to reduce the effect of the detected fault. Once the alarm is cleared, an aging timer is started. When the aging timer expires, the graphical display system determines if the graphical object has been designated as one of a selected group of graphical objects that are to be permanently displayed. If not, the graphical display system next determines if the graphical object contains any active

alarms. If the graphical object does contain one or more active alarms, the graphical object is retained by the graphical display system until all active alarms are cleared. On the other hand, if the graphical object does not contain any other active alarms, the graphical object is removed from the display and deleted. The next higher graphical object in the hierarchy is then evaluated to determine if it has been assigned as a permanent graphical object or if it has any active alarms. If not, then this higher graphical object is also deleted. This purging process continues until a graphical object is reached that has been designated as permanent or that contains an active alarm.

Accordingly, the method and system of the present invention avoid the need for a database that stores information on all elements of the network by reconstructing the necessary portions of the network from information contained within an alarm message. Furthermore, the graphical display system displays only those graphical objects that are implicated by the existing alarms in the network to increase the efficiency of the fault management system.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, reference is made to the following detailed description taken in conjunction with the accompanying drawings wherein like reference characters denote like or similar parts throughout the various Figures and wherein:

FIGURES 1A, 1B, and 1C, are an exemplary graphical object tree, an exemplary managed object tree, and an exemplary hierarchy of network elements that form a network, respectively;

FIGURES 2A, 2B, and 2C, are an exemplary graphical object tree, an exemplary managed object tree, and an exemplary hierarchy of network elements that form a network, respectively, wherein there is one occluding graphical object that represents a group of managed objects;

FIGURES 3A, 3B, and 3C, are an exemplary graphical object tree, an exemplary managed object tree, and an exemplary hierarchy of network elements that form a network, respectively, wherein some of the network elements are not represented in the managed object tree or the graphical object tree;

FIGURE 4 is a flow diagram of a method for displaying network fault information in a graphical display system in accordance with the present invention;

FIGURE 5, is an exemplary structure of an alarm message for use in connection with one embodiment of the present invention;

FIGURES 6A, 6B, and 6C are an exemplary graphical object tree, an exemplary managed object tree, and an exemplary hierarchy of network elements that form a network, respectively, illustrating one embodiment of the present invention; and

FIGURE 7 is a system for monitoring alarm information in a network in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In a data or telecommunication network, network elements can be organized in a variety of different topologies, although hierarchical arrangements are most prevalent. Such an arrangement is implemented, for example, in a digital hierarchy

of transmission network, in network and sub-network relations, and in logical name convention.

Referring now to FIGURES 1A, 1B, and 1C, there is illustrated an exemplary graphical object tree 8, an exemplary managed object tree 6, and an exemplary hierarchy of network elements 10 that form a network 4, respectively. Each network element 10 is represented by a corresponding managed object 12, which resides in the software of the fault management system. The managed object tree 6 also represents the relationships among the various network elements. The managed object tree 6 is in turn represented in a graphical display system by a corresponding graphical object tree 8, having one graphical object 14 for each managed object 12. Because of this one to one relationship between the managed objects 12 (and/or the network elements 10) and the graphical objects 14, an alarm for a particular network element 10 can be distinctly displayed in the graphical display system by a unique graphical object 14.

Such a one to one relationship is desirable. However, in a large network, having millions of network elements 10, a complete graphical object tree 8 is impossible because, as the network 4 evolves, it is impossible to maintain complete correlation (or synchronization) between the graphical object tree 8, the managed object tree 6, and the hierarchy of network elements 10. Such large networks require hours to perform complete synchronization. By the time the synchronization task is completed, the real network may have further evolved or changed in comparison to the updated managed object and graphical object trees 6 and 8. In addition, the time required to download the entire graphical display system from an Internet-based server might be prohibitively long, precluding the possibility of implementing the graphical display system in the popular Internet browser environment.

Referring now to FIGURES 2A, 2B, and 2C, there is illustrated an exemplary graphical object tree 8, an exemplary managed object tree 6, and an exemplary hierarchy of network elements 10 that form a network 4, respectively, wherein there is one occluding graphical object 14' that represents a group of managed objects 12. Such an arrangement decreases the size of the graphical object tree 8 and can be used to increase the speed of the graphical display system to an acceptable level and to limit the synchronization problem described above. As a result, however, the occluding graphical object 14' must display an alarm indication whenever any of the network elements 10 in its underlying sub-tree generates an alarm. Furthermore, the occluding graphical object 14' must show the highest alarm severity of all the managed objects 12 in its sub-tree. If managed object 12_1 has an alarm of critical severity while managed object 12_2 has a minor alarm, the occluding graphical object 14' will indicate a critical alarm state because that is the higher severity alarm.

Implementation of this type of graphical display system places a high burden on processing resources. This is because the behavior of the occluding graphical object 14' is related to the alarm states of all of the underlying managed objects 12. In cases where a network element 10 corresponding to one of the underlying managed objects 12 reports alarm on and off in rapid succession, for instance, the processing load for determining the behavior of the occluding graphical object 14' can slow the graphical display system to an unacceptable level. The processing load can be further increased by navigation and zooming operations of the graphical display system operator.

Moreover, when the occluding graphical object 14' represents a large number of underlying managed objects 12, the occluding graphical object 14' is likely to be

in an alarmed state most or all of the time since it is likely that at least one of the underlying managed objects 12 is in an alarmed state at any given time. For example, if the occluding graphical object 14' corresponds to a switch representing thousands of network elements 10 within a switch, then it is highly likely that the occluding graphical object 14' will be in an alarmed state all the time. This result defeats the purpose of a graphical monitoring system and reduces the effectiveness of the graphical display system.

Referring now to FIGURES 3A, 3B, and 3C, there is illustrated an excmplary graphical object tree 8, an exemplary managed object tree 6, and an exemplary hierarchy of network elements 10 that form a network 4, respectively, wherein some of the network elements 12 are not represented in the managed object tree 6 or the graphical object tree 8. This situation frequently arises where the graphical display system and/or fault management system are not synchronized with the network. In this case, when the fault management system receives an alarm emitted by one of the unrepresented managed objects 12, the graphical display system indicates the alarm state by altering the behavior of a "catch all" graphical object 14", which is used for displaying fault information about all network elements 10 that are unknown to the fault management system. If numerous network elements 10 are unknown to the fault management system, the "catch all" graphical object 14" will almost always be in the alarmed state, and the effectiveness of the graphical display system will again be diminished.

One alternative to the use of a management information base, which must be manually updated to maintain synchronization with the real network, is to allow the graphical display system to create a new graphical object 14 whenever it receives an

alarm containing an unknown network element 10 name. The problem with this approach is that after some time in operation the graphical object tree size becomes too large causing many of the same problems as are described in connection with FIGURES 1A-1C and 2A-2C. In addition, the graphical objects 14 and managed objects 12 that correspond to retired network elements 10 (i.e., network elements 10 that have been removed from the network 4) may remain in the management information base, reducing the accuracy of the graphical display system and potentially causing operator confusion.

In accordance with a preferred embodiment of the present invention, a fault management system includes a graphical display system that does not maintain a management information base for the entire network 4. Instead, the graphical display system creates a small number of top level graphical objects 14 at start-up. These top-level graphical objects 14 are never deleted from the graphical display system, and the graphical display system displays these top-level graphical objects 14 regardless of their alarm status (i.e., active alarm or no alarm). Preferably, the top-level graphical objects 14 represent network elements 10 that are not created or destroyed often and that tend to be stable in terms of configuration. The top-level graphical objects 14 might represent, for example, switches, service areas, submarine cables, satellites, and earth-based stations. Alarms for the top-level network elements 10 can be easily represented using these permanent graphical objects 14.

When alarms for lower level network elements 10 are received by the fault management system, the graphical display system creates a graphical object 14 for each of the affected network elements 10 and displays only the newly created graphical objects 14 along with an indication of their alarm status. Generally, the

affected network elements 10 will include all network elements 10 that are above the alarmed element 10 in the hierarchy. Once the fault that caused the alarm is handled, the graphical object 14 that was the source of the alarm is deleted from the graphical display system. In addition, any other graphical objects 14 that were created and displayed as a result of the alarm (e.g., graphical objects 14 that represent network elements 10 that are above the alarmed network element 10 in the network hierarchy) are also deleted.

Thus, in accordance with a preferred embodiment of the invention, the graphical display system does not require a large management information base to store information and graphical objects 14 for all of the network elements 10 throughout the network 4. The problem of maintaining synchronization between the graphical object tree 8, the managed object tree 6, and the actual network elements 10 is avoided, as is the need to perform manual updates to a management information base. The number of graphical objects 14 is also held to the same order of magnitude as the number of current network alarms. Since the number of graphical objects 14 under this scenario is relatively small (on the order of hundreds rather than thousands or millions in a graphical display system that displays all of the graphical objects 14 in the system), the graphical display system can respond quickly to alarms and can be implemented in an Internet-based environment. In addition, the graphical display system maintains a one to one relationship between network elements 10 and their associated graphical objects 14, thereby improving the effectiveness of the graphical display system in comparison to systems that use one graphical object 14 to represent many network elements 10 (see FIGURES 2A-2C).

Referring now to FIGURE 4, there is illustrated a flow diagram of a method for displaying network fault information in a graphical display system in accordance with the present invention. At step 100, an alarm message is received by the graphical display system. The alarm message includes an indication of the alarm event or condition and the name of the alarmed network element 10. In addition, the alarm message identifies a context for the alarmed network element 10, which preferably includes the entire chain of higher network elements 10 from the network element 10 that immediately supervises the alarmed network element 10 up to the highest network element 10 in the hierarchy. At step 102, the name of the alarmed network element 10 is extracted from the alarm message, and at step 104, an attempt is made to find a graphical object 14 that is associated with the alarmed network element 10. Such an associated graphical object 14 might already exist, for example, if the alarmed network element 10 already has an existing alarm condition, if it is part of a chain of elements relating to an existing alarm condition (i.e., for an alarm in an element that is subordinate to the alarmed element), or if the alarmed network element 10 is one of the small number of permanent top level graphical objects 14.

If a graphical object 14 associated with the alarmed network element 10 does not already exist, then a graphical object 14 is created at step 106. In addition, a context for the alarmed graphical object 14, as identified from information extracted from the alarm message, is also created. Once created, the graphical object 14 associated with the alarmed network element 10 along with all of the context graphical objects 14 are displayed on an operator's monitor. If a graphical object 14 associated with the alarmed network element 10 does already exist, then a new graphical object 14 does not need to be created. Presumably, if the alarmed graphical object 14 is

already displayed, then appropriate context graphical objects 14 will also already be displayed. However, the appropriate context graphical objects 14 can be created if necessary.

Once the alarmed graphical object 14 is located or created, its behavior is altered at step 108 to reflect the type of alarm event indicated in the alarm message. For example, the graphical display system might cause the alarmed graphical object 14 to blink in red if the alarm condition is critical or to change to the color yellow if the alarm is of a non-critical nature. Next, at step 110, it is determined if the alarm condition has been cleared. This can be done by examining the alarm message to determine if it indicates that the alarm has been cleared. Typically, an initial alarm message indicates a particular fault condition. Once the fault is corrected, another alarm message is sent with the perceived severity field of the message set to "clear". If the alarm message received at step 100 is not an alarm "clear" message, then the process ends at step 124.

Eventually, the alarm condition will be cleared, and an alarm message is received for the graphical object indicating that the alarm should be cleared. Once the alarm is cleared, an aging timer is started at step 112. The aging timer allows the alarmed graphical object 14 and its context graphical objects 14 to remain on the graphical display for a preselected period after the alarm condition has been handled. This preselected period is used for the convenience of the operator and to prevent the need for creating another graphical object 14 representing the same network element 10 should another alarm involving the same graphical object 14 occur shortly after the original alarm is cleared. Preferably, during this preselected period, the behavior of

the graphical object 14 is again altered to indicate that no alarm condition currently exists.

At step 114, it is determined if the aging timer has expired. Once the aging timer has expired, it is then determined if the previously alarmed graphical object 14 has been designated in a memory associated with the graphical display system as one of the relatively small number of permanent graphical objects 14. If so, the process ends without further action at step 124. If the graphical object 14 is not designated as permanent, it is next determined at step 118 whether the graphical object 14 is associated with a managed object 12 or network element 10 that has an active alarm by examining a graphical display system memory that stores alarm information. If the graphical object 14 does have an active alarm, the process ends without further action at step 124. As a result, the graphical object 14 remains on the operator's display, at least until the remaining alarms for the network element 10 (and all of its subordinate network elements 10) are cleared. If no active alarms are associated with the graphical object 14, the graphical object 14 is removed from the display and deleted from the memory of the graphical display system at step 120.

The process then continues by initiating at step 122 an examination of the next higher graphical object 14 in the hierarchy to determine if it should be removed from the graphical display system. In other words the next higher graphical object 14 is analyzed at steps 116 and 118 to determine if it has been designated as permanent or if it (or any of its other subordinate network elements 10) contain active alarms. The process repeats these steps 116 to 122 until a graphical object 14 is reached that is permanent or that contains an active alarm. In this manner, each of the context

graphical objects 14 are deleted from the graphical display system to prevent any unnecessary display of graphical objects 14.

Referring now to FIGURE 5, there is illustrated an exemplary structure of an alarm message 20 for use in connection with one embodiment of the present invention. The alarm message 20 includes an alarm indicating field 22 that identifies the alarm condition and the perceived severity of the alarm. The alarm message 20 further includes a plurality of fields 24, 30, and 36 that include information about each of the network elements 10 in the chain that leads from the highest network element 10 (field 24) of the hierarchy down to the alarmed network element 10 (field 36). Each of these fields 24, 30, and 36 contain data 26, 32, and 38 that identifies the type of network element 10 and a name 28, 34, and 40 for each of the network elements 10 in the chain. In the illustrated example, "Element 3" is the alarmed network element 10. Using the information encoded in the alarm message 20, the graphical display system can reconstruct the affected portions of the network 4 on the operator's monitor as interconnected graphical objects 14.

Referring now to FIGURES 6A, 6B, and 6C, there is shown an exemplary graphical object tree 8, an exemplary managed object tree 6, and an exemplary hierarchy of network elements 10 that form a network 4, respectively, illustrating an embodiment of the present invention. The network 4 includes a plurality of network elements 10_1-10_{12} that are interconnected in a hierarchical arrangement. In this example, network element 10_8 has generated a critical alarm (as indicated by the filled node) network element 10_{11} has generated a non-critical alarm (as indicated by the cross-hatched node). The corresponding managed object tree 6 includes a plurality of managed objects 12_1-12_4 and 12_{10} (those above the dashed line) that have been

designated as permanent. Similarly, the graphical object tree 8 includes a corresponding plurality of graphical objects 14_1-14_4 and 14_{10} that have been designated as permanent. No other managed objects 12 or graphical objects 14 are maintained in the graphical display system on a permanent basis.

Instead, managed objects 12_8 and 12_{11} corresponding to the alarmed network elements 10_8 and 10_{11} are created by the graphical display system upon receipt of the alarm messages. These managed objects 12_8 and 12_{11} are used to store the alarm information for the corresponding network elements 10_8 and 10_{11}. In addition, context managed objects 12_5 and 12_7 are created by the graphical display system and are used to store an indication that one of their subordinate managed objects 12_8 has generated an alarm message 20. Similarly, graphical objects 14_8 and 14_{11} corresponding to the alarmed network elements 10_8 and 10_{11} are created by the graphical display system upon receipt of the alarm messages and assigned appropriate behaviors for displaying their respective alarm conditions. In addition, context graphical objects 14_5 and 14_7 are created by the graphical display system to give the operator a sense of the context of the alarmed network element 10_8 by, in this case, displaying the entire chain of graphical objects 14 from the top of the hierarchy down to the alarmed graphical objects 14_8 and 14_{11}.

Once the alarm condition for network element 10_{11} is cleared, managed object 12_{11} and graphical object 14_{11} are removed from the graphical display and deleted from memory. Similarly, once the alarm condition for network element 10_8 is cleared, managed object 12_8 and its superior managed objects 12_5 and 12_7 as well as graphical object 14_{11} and its superior graphical objects 14_5 and 14_7 are removed from the graphical display and deleted from memory. In both cases, however, the removal and

deletion process does not affect any of superior managed objects 12_1, 12_3, 12_4, and 12_{10} or superior graphical objects 14_1, 14_3, 14_4, and 14_{10} because of their permanent status.

Referring now to FIGURE 7, there is illustrated a system 2 for monitoring alarm information in a network 4 in accordance with one embodiment of the present invention. The network 4 includes a plurality of network elements 10 ("NE1"-"NE4") that are monitored by a fault management system 50. The fault management system 50 receives alarms from the network elements 10 and forwards the alarm information to an attached graphical display system 52. The graphical display system 52 stores the alarm information in an attached memory 54 and creates appropriate managed objects 12 and graphical objects 14 in accordance with the received alarms. For ease of illustration, the graphical display system 52 and the attached memory are depicted as being located near the fault management system 50. In the illustrated example, an operator using a computer terminal 58 can then access the graphical display system 52 via the Internet 56 to display the alarmed graphical objects 14. Using the displayed information, the operator is able to quickly and efficiently evaluate the faults in the network 4 and initiate appropriate corrective action. Preferably, however, the graphical display system 52 and the attached memory reside in the computer 58. The necessary software for the graphical display system 52, for example, can be downloaded via the Internet 56 and run on the operator's workstation 58.

Although a preferred embodiment of the method and apparatus of the present invention has been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it is understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications, and

substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

Claims

WHAT IS CLAIMED IS:

1. A method for monitoring network status information, comprising the steps of:

receiving a status message indicating a particular status for a specified element in a network;

extracting information about the specified element from the status message;

creating a graphical object for the specified element based on the extracted information;

displaying the graphical object on an operator interface;

identifying a change in the status for the specified element; and

removing the graphical object from the operator interface in response to the identification of the change in the status for the specified element.

2. The method of claim 1, wherein the network comprises a telecommunication network.

3. The method of claim 1, wherein the network comprises a data network.

4. The method of claim 1, further comprising the steps of:

storing the graphical object in a memory; and

deleting the graphical object from the memory in response to the identification of the change in the status for the specified element.

5. The method of claim 1, wherein the status message comprises a fault message for the specified element.

6. The method of claim 5, wherein the graphical object includes an indication of the received fault message.

7. The method of claim 6, wherein the step of identifying a change in the status for the specified element is in response to a handling of the fault by a network operator.

8. The method of claim 5, wherein the network comprises a hierarchical arrangement of a plurality of network elements, the specified element having a plurality of supervising network elements higher in the hierarchical arrangement than the specified element and identified by the extracted information, further comprising the steps of:

creating a context graphical object for each supervising network element; and

displaying each context graphical object on the operator interface.

9. The method of claim 8, further comprising the step of removing each context graphical object from the operator interface in response to the identification of the change in the status for the specified element.

10. The method of claim 8, further comprising the steps of:

creating a plurality of permanent graphical objects representing a plurality of preselected network elements; and

displaying each permanent graphical object on the operator interface.

11. The method of claim 10, further comprising the steps of:

determining, for a plurality of network elements that are higher in the hierarchical arrangement than the specified element and in response to the identification of the change in the status for the specified element, whether each of the network elements that are higher in the hierarchical arrangement is one of the plurality of permanent graphical objects;

removing from the graphical display each graphical object that is not one of the plurality of permanent graphical objects and that represents a network element that is higher in the hierarchical arrangement.

12. The method of claim 8, wherein the status message identifies an interconnection among and between the specified element and the plurality of supervising network elements higher in the hierarchical arrangement than the specified element.

13. The method of claim 5, further comprising the step of storing the fault message in a database.

14. The method of claim 12, wherein the step of identifying a change in the status for the specified element includes determining whether a fault message associated with the specified element is stored in the database.

15. The method of claim 1, wherein the step of removing the graphical object from the operator interface comprises the steps of:

starting an aging timer; and

removing the graphical object from the operator interface when the aging timer expires.

16. A system for monitoring alarm information in a network, comprising:

a network including a plurality of network elements;

a fault management sub-system for receiving alarms from at least one alarmed element in the network;

a user interface for displaying alarm information;

a graphical display sub-system connected to the fault management sub-system and to the user interface, the graphical display sub-system operating to:

extract an identification of the at least one alarmed element from an alarm message;

create a graphical object representing the at least one alarmed element, in response to the alarm message received from the at least one alarmed element;

display the graphical object on the user interface; and

remove the graphical object from the user interface after an alarm condition indicated by the alarm message is cleared.

17. The system of claim 16, wherein the graphical display sub-system further operates to:

create a plurality of context graphical objects for network elements that are associated with the at least one alarmed element; and

display the plurality of context graphical objects on the user interface.

18. The system of claim 17, wherein the graphical display sub-system further operates to remove the plurality of context graphical objects from the user interface after an alarm condition indicated by the alarm message is cleared.

19. The system of claim 17, wherein the graphical display sub-system retrieves an identification of the network elements that are associated with the at least one alarmed element from the alarm message.

20. The system of claim 16, wherein the graphical display sub-system removes the graphical object from the user interface after an elapse of a predetermined period after an alarm condition indicated by the alarm message is cleared.

21. A method for monitoring alarm information in a network without using a management information base for maintaining information about structure of the network and the elements in the network, comprising the steps of:

receiving an alarm message from an alarmed element in the network;

creating an alarmed graphical object corresponding to the alarmed element; and

displaying the alarmed graphical object on a user interface.

22. The method of claim 21, further comprising the step of extracting information about the alarmed element from the alarm message wherein the alarmed graphical object is created based on the extracted information.

23. The method of claim 22, further comprising the steps of:

determining that an alarm condition identified by the alarm message has been cleared; and

removing the alarmed graphical object from the user interface.

24. The method of claim 23, further comprising the steps of:

creating at least one context graphical object based on the extracted information, each context graphical object representing a network element that is related to the alarmed element;

displaying the at least one context graphical object on the user interface; and

removing the at least one context graphical object from the user interface in response to the determination that an alarm condition identified by the alarm message has been cleared.

25. The method of claim 24, further comprising the step of displaying an interconnection between the at least one graphical object and the alarmed graphical object, wherein said interconnection represents an interconnection between the alarmed element and the at least one network element that is related to the alarmed element.

26. The method of claim 24, wherein the step of removing the at least one context graphical object from the user interface is performed in response to a determination that no current alarm conditions are associated with the at least one context graphical interface.

27. The method of claim 26, further comprising the steps of:

creating at least one permanent graphical object representing at least one network element that is preselected for permanent display;

displaying the at least one permanent graphical object on the user interface, wherein the step of removing the at least one context graphical object from the user interface is performed in response to a further determination that the at least one context graphical interface is not a permanent graphical object.

28. The method of claim 23, wherein the step of removing the alarmed graphical object from the user interface is performed a predetermined amount of time

after the step of determining that the alarm condition identified by the alarm message has been cleared.

29. The method of claim 22, wherein the alarm message is received via the Internet.

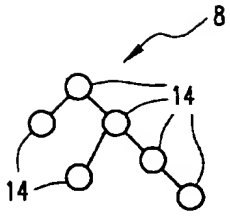

FIG. 1A

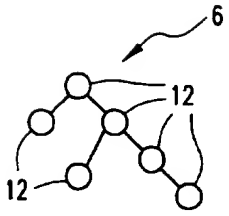

FIG. 1B

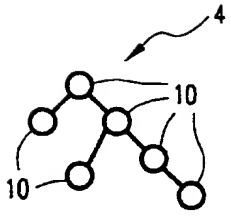

FIG. 1C

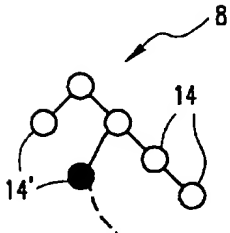

FIG. 2A

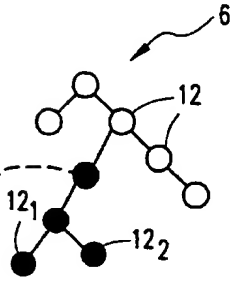

FIG. 2B

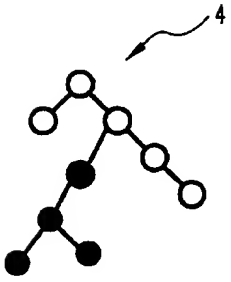

FIG. 2C

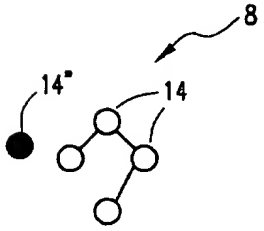

FIG. 3A

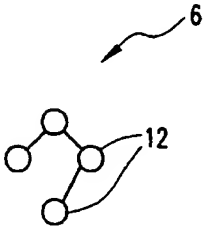

FIG. 3B

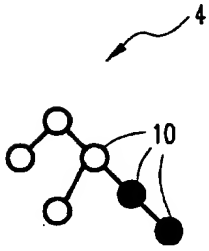

FIG. 3C

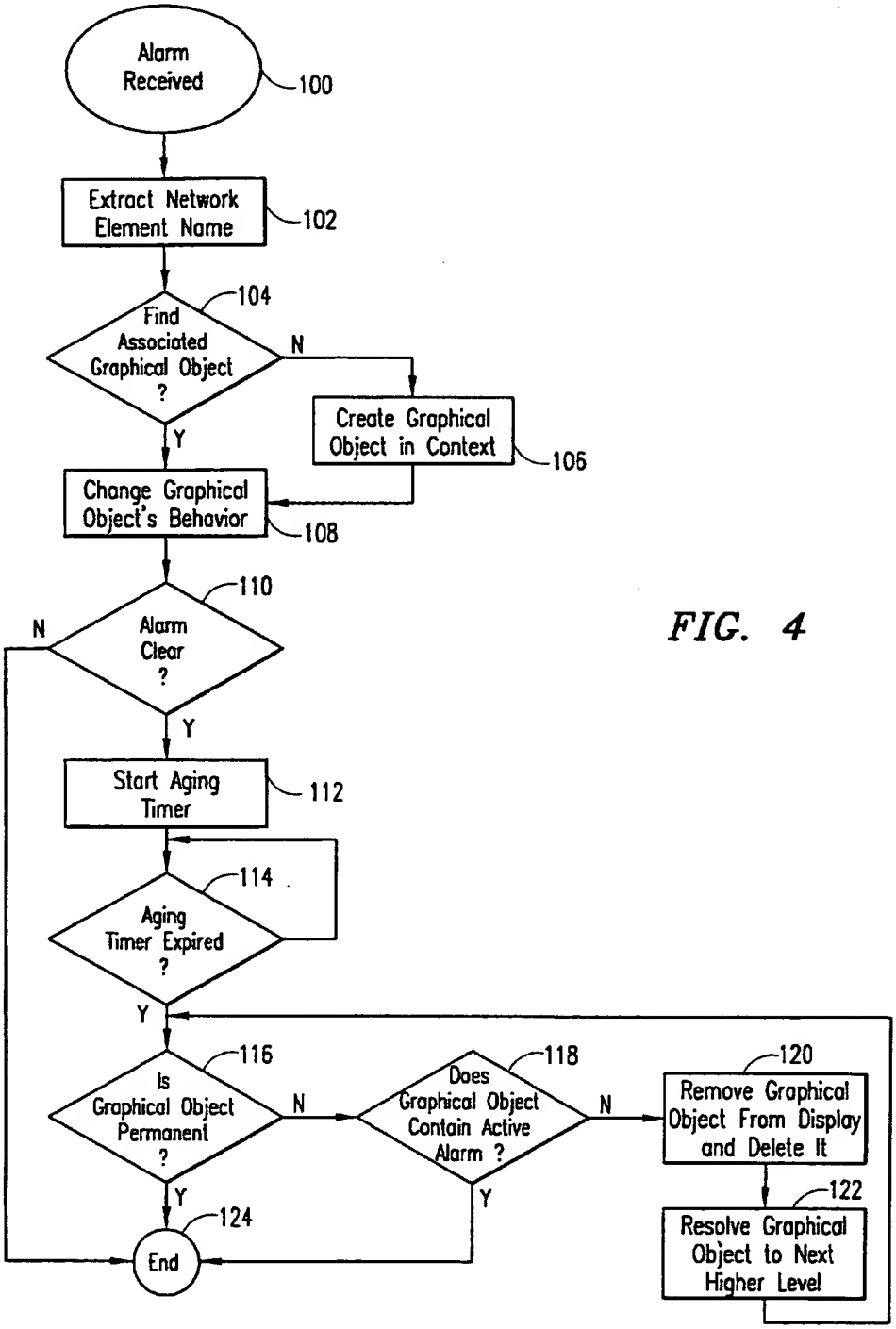
Alarm Received
100
Extract Network Element Name
102
Find Associated Graphical Object ?
104
N
Y
Create Graphical Object in Context
106
Change Graphical Object's Behavior
108
Alarm Clear ?
110
N
Y
Start Aging Timer
112
Aging Timer Expired ?
114
Y
Is Graphical Object Permanent ?
116
N
Y
Does Graphical Object Contain Active Alarm ?
118
N
Y
Remove Graphical Object From Display and Delete It
120
Resolve Graphical Object to Next Higher Level
122
End
124

FIG. 4

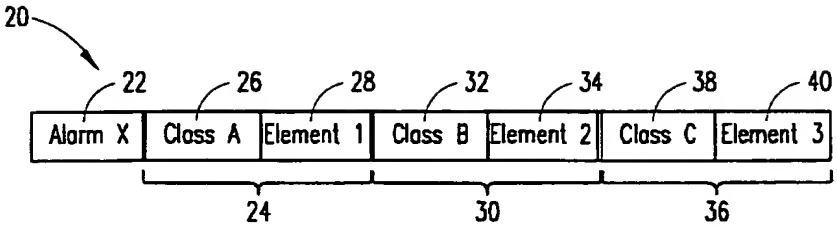

FIG. 5

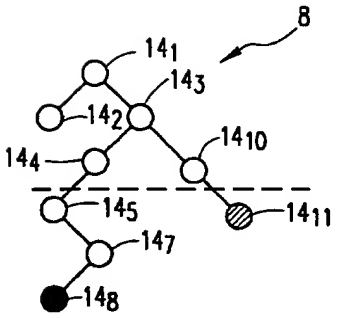

FIG. 6A

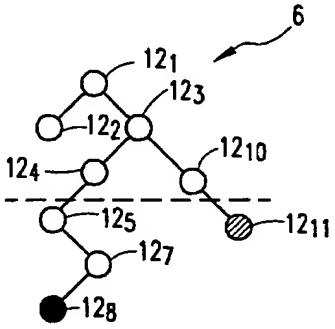

FIG. 6B

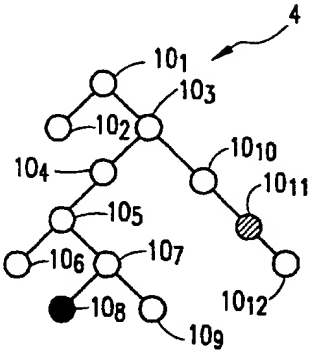

FIG. 6C

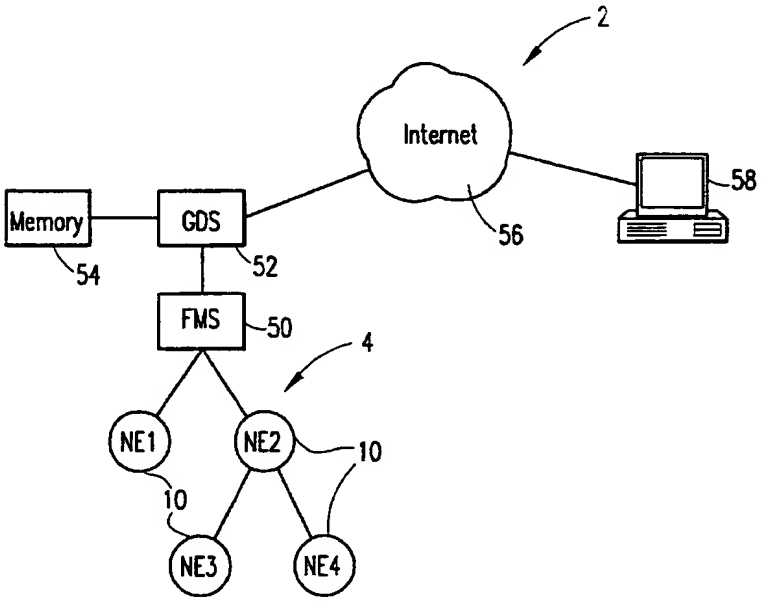

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/00816

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 12/24
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0909056 A2 (HEWLETT-PACKARD COMPANY), 14 April 1999 (14.04.99), page 2, line 57 - page 3, line 5; page 3, line 41 - page 4, line 40	1-29
Y	US 5884072 A (RASMUSSEN), 16 March 1999 (16.03.99), column 62, line 46 - line 54; column 63, line 29 - line 41; column 65, line 51 - line 67	1-29
A	US 5285494 A (SPRECHER ET AL), 8 February 1994 (08.02.94), column 4, line 13 - line 32	1-29

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 August 2000	13 09 2000
Name and mailing address of the International Searching Authority European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel.+31-70)340-2040, Tx 31 651 epo nl, Fax:+31-70)340-3018	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/00816

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5751965 A (MAYO ET AL), 12 May 1998 (12.05.98), abstract -- --------	1-29

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SE 00/00816

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		CA 2244009 A	31/07/91
		DE 69108900 D	00/00/00
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